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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/905,157	07/12/2001	Nathan S. Lewis	CIT1270-1	2732

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EXAMINER

KIELIN, ERIK J

ART UNIT PAPER NUMBER

2813

DATE MAILED: 05/03/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/905,157

Applicant(s)

LEWIS ET AL.

Examiner

Erik Kielin

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 10 February 2005.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,4-8,11-13,16-27,30-41 and 43-53 is/are pending in the application.
- 4a) Of the above claim(s) 6-8,18-20 and 31-40 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,4,5,11-13,16,17,21-27,30,41 and 43-53 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submissions filed on 26 October 2004 and 10 February 2005 have been entered.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 11, 12, 30 and 43 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

The instant specification fails to provide how one of ordinary skill can carry out the claimed feature of the semiconductor substrate of claim 1 "further comprising a substantially amorphous silicon-containing material to the substrate," or "further comprising a porous silicon-containing material immediately adjacent to the organic layer," while still possessing presently claimed electrical properties. The instant specification only provides evidence for

monocrystalline silicon only (instant specification paragraphs [0065]-[0070] --especially [0065]). Accordingly, this is not enabled.

4. Claims 11, 12, 30, and 43 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. For the reasons indicated above, and because there exists nothing on the record, particularly no evidence, that the electrical properties presently claimed could exist in a monocrystalline substrate **further comprising amorphous or porous silicon immediately adjacent to the organic layer**, this is new matter.

5. Claim 41 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Dependent claim 41, which depends from independent claim 1, claims the substrate of claim 1 prior to conversion. Applicant cannot simultaneously claim the substrate before and after treatment. Moreover, once the substrate has the organic layer attached to it, it is no longer hydrogen-terminated. Accordingly, the limitation of claim 41 is irrelevant since it is not in the product of claim 1.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

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A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. Claims 1, 4, 5, 11, 13, 16, 17, 21, 25-27, 30, 41, and 43-53 are rejected under 35

U.S.C. 102(b) as being anticipated by US 5,429,708 (**Linford** et al.).

Regarding claims 1, 11 and 13, 30, **Linford** discloses a semiconductor substrate comprising,

providing an, *inter alia*, monocrystalline or amorphous (instant claims 11 and 30) or porous silicon-containing material 12 (col. 1, lines 17-21) having a surface 40 substantially free of oxidation (as shown in Figs. 2A, 2B, 3, etcetera; and as stated at col. 2, lines 6-45); and

forming an organic monolayer 44, 45, 46 having more than half of its atoms being carbon and hydrogen (because R is, *inter alia*, alkyl, alkenyl, aryl, cycloalkyl..." [col. 5, lines 5-13] which are 100% carbon and hydrogen) wherein the organic layer is chemically bonded to the surface 10, 30, 32, 38 of the silicon-containing material 12 (col. 2, lines 6-45) and wherein an electrical property of the electrical structure is altered and/or improved compared to a same substrate without the organic layer, as indicated by **Linford** (col. 1, 21-31; paragraph bridging cols. 8-9; all figures).

For example, **Linford** states in the paragraph bridging cols. 8-9,

"For example, such molecular layers are suitable for use with: silicon based, micromechanical devices to minimize stiction; **electrode surfaces** to **optimize** their **electrochemical properties** for use in **fuel cells** or **electrochemical synthetic cells**; **solar cells as an antioxidation coating**, silicon chips as a monomolecular photoresist, and Si-based chemical sensors to **alter the electrical properties** of the underlying Si." (Emphasis added.)

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The word “optimization,” by definition, is to improve, and the word “alter” is a synonym of the word “change.” Accordingly, **Linford** expressly and inherently teaches both changing and improving of the electrical properties of the semiconductor substrate.

It is seen to be inherent that the organic layer of **Linford** changes the electrical property of the silicon-containing material, wherein the electrical properties are selected from a group consisting of surface recombination velocity, carrier lifetime, electronic efficiency, voltage, contact resistance, and resistance of a doped region, in addition to those presently added regarding the carrier lifetime (claims 1, 13, and 44-53). Evidence is the admission of Applicant in the instant specification (for example at p. 7, paragraph [0031] and paragraph bridging pp. 15-16, [0056]).

See *In re Swinhart*, 169 USPQ 226,229 (CCPA 1971) (where the Patent Office has reason to believe that a functional limitation asserted to be critical for establishing novelty in the claimed subject matter may, in fact, be an inherent characteristic of the prior art, it possesses the authority to require the applicant to prove that subject matter shown to be in the prior art does not possess the characteristics relied on) and *In re Fitzgerald*, 205 USPQ 594 (CCPA 1980) (the burden of proof can be shifted to the applicant to show that subject matter of the prior art does not possess the characteristic relied on whether the rejection is based on inherency under 35 USC 102 or obviousness under 35 USC 103).

Note that as long as there is evidence of record establishing inherency, failure of those skilled in the art to contemporaneously recognize an inherent property, function or ingredient of a prior art reference does not preclude a finding of anticipation. *Atlas Powder Co. v. IRECO, Inc.*, 190 F.3d 1342, 1349, 51 USPQ2d 1943, 1948 (Fed. Cir. 1999) (Two prior art references

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disclosed blasting compositions containing water-in-oil emulsions with identical ingredients to those claimed, in overlapping ranges with the claimed composition. The only element of the claims arguably not present in the prior art compositions was “sufficient aeration . . . entrapped to enhance sensitivity to a substantial degree.” The Federal Circuit found that the emulsions described in both references would inevitably and inherently have “sufficient aeration” to sensitize the compound in the claimed ranges based on the evidence of record (including test data and expert testimony). This finding of inherency was not defeated by the fact that one of the references taught away from air entrapment or purposeful aeration.). See also *In re King*, 801 F.2d 1324, 1327, 231 USPQ 136, 139 (Fed. Cir. 1986); *Titanium Metals Corp. v. Banner*, 778 F.2d 775, 782, 227 USPQ 773, 778 (Fed. Cir. 1985).

In the decision in *Toro Co. v. Deere & Co.*, 69 USPQ2d 1584 (CA FC 2004), at page 1590, last paragraph, it was held that if “one or more embodiments -- whatever the settings of their operational features -- [] necessarily include or result in the subject matter of [the] limitation,” then inherent anticipation of the limitation exists.

Regarding claim 4, the organic layer is a hydrocarbon (Fig. 4; col. 4, line 44 to col. 5, line 13).

Regarding claims 5 and 17, the organic layer is a polymer 46 (Fig. 12; col. 5, lines 37-45).

Regarding claim 16, the organic layer is a monolayer (Figs. 3-12).

Regarding claims 21, the organic layer is formed by activating the surface of the silicon-containing material; and reacting the activated surface with a chemical, wherein during the

reaction, a hydrocarbon group becomes chemically bonded to the silicon-containing material.
(See col. 2, lines 6-45.)

Regarding claim 25, the hydrocarbon is an allyl, called “alkenyl” and structurally described as “-C(R)=CH(R’)” for example, in **Linford** (col. 5, lines 5-34).

Regarding claim 26, a polymer is formed by reaction with the surface-bound allyl group (col. 5, lines 37-46; paragraph bridging cols. 5 and 6).

Regarding claim 27, the hydrocarbon group is an alkoxide group (col. 4, lines 44-49; Fig. 5).

Regarding claim 41, **Linford** uses a hydrogen-terminated silicon surface prior to forming the organic layer (Abstract).

8. Claims 1, 4, **13**, 16, 21-24, 41, 43-47, and 49-52 are rejected under 35 U.S.C. 102(b) as being anticipated by the article **Bansal** et al. (an instant inventor, **Nathan S. Lewis** being listed as a co-author) “Alkylation of Si surfaces using a two-step halogenation/Grignard route” Journal of the American Chemical Society, Vol. 118, 1996, pp. 7225-7226.

Regarding independent claims 1 and 13, **Bansal** discloses a process of forming a semiconductor substrate and the substrate produced thereby comprising,

providing a hydrogen-terminated monocrystalline silicon substrate --as further limited by instant claim 41;

activating the hydrogen-terminated silicon surface, substantially free of oxidation, by chlorinating the hydrogen-terminated surface --as further limited by instant claims 21 and 22;

and reacting the activated silicon surface with an alkyl lithium or Grignard reagent to replace the chlorine atoms of the terminated sites with a monolayer of the alkyl group of the alkyl lithium or Grignard reagent, wherein the exemplary alkyl groups have 1 (methyl), 2 (ethyl), 4 (butyl), 5 (pentyl), 6 (hexyl), 10 (decyl), 12 (dodecyl), or 18 (octadecyl) carbons --as further limited by instant claims 4, 16, and 21-24.

While **Bansal** does not discuss the electrical properties (such as carrier lifetime) of the alkylated silicon substrate, it is held, absent evidence to the contrary, that the alkylated silicon substrate must have all of the same properties, electrical or otherwise, since the structure is the same as disclosed and claimed, and therefore reads on the properties as claimed in claims 1, 13, 43-47, and 49-52. (Compare the **Bansal** method to one of the methods of the instant specification, as recited in paragraphs [0046]-[0047] and [0066]-[0070], being claimed by Applicant to give the claimed electrical properties in the alkylated silicon substrate. Applicant's admissions in the instant specification provide additional evidence of inherency.)

In this regard, the following case law is believed relevant. In the decision in *Toro Co. v. Deere & Co.*, 69 USPQ2d 1584 (CA FC 2004), at page 1590, last paragraph, it was held that if “**one or more embodiments** --whatever the settings of their operational features-- [] necessarily include or result in the subject matter of [the] limitation,” then inherent anticipation of the limitation exists. (Emphasis added.)

The claiming of a new use, new function or unknown property which is **inherently present** in the prior art does not necessarily make the claim patentable. See *In re Best*, 562 F.2d 1252, 1254, 195 USPQ 430, 433 (CCPA 1977). Anticipation by a prior art reference **does not require either the inventive concept of the claimed subject matter or the recognition of**

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inherent properties that may be possessed by the prior art reference. See *Verdegaal Bros. Inc. v. Union Oil Co.*, 814 F.2d 628, 633, 2 USPQ2d 1051, 1054 (Fed. Cir.), cert. denied, 484 U.S. 827 (1987). A prior art reference anticipates the subject matter of a claim when the reference discloses every feature of the claimed invention, **either explicitly or inherently.** See *Hazani v. Int'l Trade Comm'n*, 126 F.3d 1473, 1477, 44 USPQ2d 1358, 1351 (Fed. Cir. 1997) and *RCA Corp. v. Applied Digital Data Systems, Inc.*, 730 F.2d 1440, 14.44, 221 USPQ 385, 388 (Fed. Cir. 1984). The law of anticipation **does not require that the reference teach what the appellants are claiming**, but only that the claims on appeal “read on” something disclosed in the reference. See *Kalman v. Kimberly-Clark Corp.*, 713 F.2d 760, 772, 218 CSPQ 781, 789 (Fed. Cir. 1983), cert. denied, 465 U.S. 1026 (1984). Note that as long as there is evidence of record establishing inherency, failure of those skilled in the art to contemporaneously recognize an inherent property, function or ingredient of a prior art reference does not preclude a finding of anticipation. *Atlas Powder Co. v. IRECO, Inc.*, 190 F.3d 1342, 1349, 51 USPQ2d 1943, 1948 (Fed. Cir. 1999) (Two prior art references disclosed blasting compositions containing water-in-oil emulsions with identical ingredients to those claimed, in overlapping ranges with the claimed composition. The only element of the claims arguably not present in the prior art compositions was “sufficient aeration . . . entrapped to enhance sensitivity to a substantial degree.” The Federal Circuit found that the emulsions described in both references would inevitably and inherently have “sufficient aeration” to sensitize the compound in the claimed ranges based on the evidence of record (including test data and expert testimony). This finding of inherency was not defeated by the fact that one of the references taught away from air entrapment or purposeful

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aeration.). See also *In re King*, 801 F.2d 1324, 1327, 231 USPQ 136, 139 (Fed. Cir. 1986); *Titanium Metals Corp. v. Banner*, 778 F.2d 775, 782, 227 USPQ 773, 778 (Fed. Cir. 1985).

See *In re Swinhart*, 169 USPQ 226,229 (CCPA 1971) (where the Patent Office has reason to believe that a functional limitation asserted to be critical for establishing novelty in the claimed subject matter may, in fact, be an inherent characteristic of the prior art, it possesses the authority to require the applicant to prove that subject matter shown to be in the prior art does not possess the characteristics relied on) and *In re Fitzgerald*, 205 USPQ 594 (CCPA 1980) (the burden of proof can be shifted to the applicant to show that subject matter of the prior art does not possess the characteristic relied on whether the rejection is based on inherency under 35 USC 102 or obviousness under 35 USC 103).

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Linford** in view of US 3,961,353 (**Aboaf et al.**).

The prior art of **Linford**, as explained above, discloses each of the claimed features except for indicating the porosity to have an upper limit of 30%.

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Aboaf teaches a semiconductor device having a porous layer of silicon **12**, wherein the silicon has a porosity of 15%. The silicon layer has a protective layer **15** formed there over to prevent oxidation in subsequent processes. (See col. 2, lines 41-61; col. 3, lines 3-13.)

It would have been obvious for one of ordinary skill in the art, at the time of the invention to limit the porosity to no greater than 15% in order to form the device in **Aboaf**. Furthermore, the degree of porosity at no greater than 30% is an obvious matter of design choice and of routine optimization, depending upon the particular application of the porous silicon, at the suggestion of **Linford** to use porous silicon --especially since Applicant has provided no reason why the percentage porosity of the silicon bears any criticality to the formation of the organic layer.

11. Claims **13**, 21-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 6-84853 A (**Tsukune** et al.) in view of **Wolf**, et al. Silicon Processing for the VLSI Era, Vol. 1-Process Technology, Lattice Press: Sunset Beach CA, 1986, p. 5:

Regarding claims 13 and 21-24, **Tsukune** discloses activating a silicon-containing material (silicon, Si) by halogenating with HF (F is the halogen) and then reacting the activated silicon-containing material surface with a chemical (methanol) to chemically bond a monolayer of methyl groups to the silicon in the surface which has only 1 carbon atom. (See paragraphs [0010]-[0012], translation provided.) **Tsukune** teaches that the electrical property of, at least, voltage in the silicon is improved (a "change") because defects are prevented in the contact between the tungsten or silicon deposited on the silicon-containing material (wafer) (paragraph [0018]). Accordingly, the contact resistance is improved.

In addition to improvement of the contact resistance, it is seen to be inherent that the organic layer also changes an electrical property of the silicon-containing material selected from a group consisting of surface recombination velocity, carrier lifetime, electronic efficiency, voltage, contact resistance, and resistance of a doped region. Evidence is the admission of Applicant in the instant specification (for example at p. 7, paragraph [0031] and paragraph bridging pp. 15-16, [0056]).

Tsukune does not indicate that the silicon semiconductor wafer is monocrystalline. If it is thought that the silicon wafer of **Tsukune** is not monocrystalline, then this may be a difference. However, **Wolf** teaches that it is notoriously well known to fabricate silicon semiconductor devices on single crystal silicon because polycrystalline silicon “would exhibit inadequately short minority carrier lifetimes, due to defects occurring at the grain boundaries of the polycrystalline grains.” Accordingly, it would have been obvious for one of ordinary skill in the art, at the time of the invention to use monocrystalline silicon wafers in **Tsukune** to ensure sufficiently high minority carrier lifetimes to enable workable semiconductor devices, as taught in **Wolf**.

Response to Arguments

12. Applicant's arguments filed 26 October 2004 have been fully considered but they are not persuasive.

Applicant's arguments regarding the absence of discussion of the inherent properties of the organic layer in Linford is not persuasive for reasons of record. There fails to exist proper evidence showing that the Linford organic layers fail to have the electrical properties claimed.

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As noted above in the *Toro v. Deere* of January 2004 decision by the CAFC, so long as at least **one embodiment** gives the claimed electrical properties, inherent anticipation exists.

Accordingly, proper evidence must eliminate all of the organic materials, particularly the methylated and ethylated surfaces for which the specification has provided evidence -- notwithstanding that there exists absolutely no evidence of record indicating that any organic layer will have the presently claimed electrical properties, since there exists only evidence for C2, C6, C8 and C12 **alkyl** groups.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 571-272-1693. The examiner can normally be reached from 9:00 - 19:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr. can be reached on 571-272-1702. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Erik Kielin
Primary Examiner
April 30, 2005